GINER. INC.

Storing oxygen for astronauts is a process made more efficient by Giner's Dimensionally Stable Membrane (DSM) for NASA's high pressure electrolyzers.

Any human mission in space, whether it is a 6-month stint aboard the International Space Station (ISS) or an interplanetary exploration expedition, requires a life support system that provides oxygen to the crew while removing carbon dioxide. Since oxygen is not readily available on orbit as it is on Earth, oxygen is made through a process known as electrolysis, where electricity is passed through water – splitting the water into hydrogen and oxygen gases.

PROJECT
Dimensionally Stable Membrane (DSM) for High Pressure Electrolyzers

MISSION DIRECTORATE
Science

PHASE III SUCCESS
$2 million in commercial revenues stemming from the NASA SBIR technology

SNAPSHOT
Massachusetts-based Giner Inc. developed a stronger membrane for use in energy storage systems, allowing for greater efficiency in oxygen storage and paving the way for new applications in the energy and automotive sectors.

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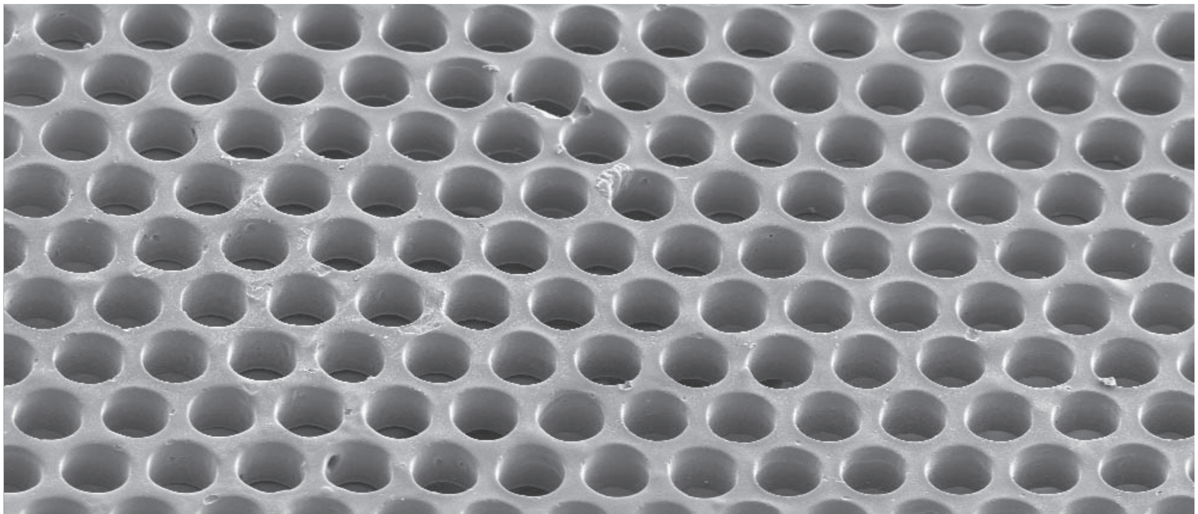
Since the life support system for the ISS provides between five and twenty pounds of oxygen per day, pressurized oxygen storage tanks are used to ensure a continual supply. Looking to increase the efficiency of electrolysis for energy storage, NASA's SBIR program solicited proposals that would advance the technology in the area of highly efficient, high-pressure proton-exchange-membrane water electrolyzers. Giner's proposed technology, which includes a stronger electrolysis membrane, not only resonated with NASA, but attracted some large customers in the commercial sector as well.

"For energy storage, efficiency is critical and our membranes address this need," says Dr. Corky Mittelsteadt, Vice President of Technology at Giner, Inc. "One of the only ways to increase electrolyzer efficiency is to increase the temperature at which you are electrolyzing. However, this makes the membrane separating the H2 and O2 weaker. At the same time, pressure of the produced gases needs to be increased in order to store them efficiently, further increasing the need for strength in the membrane."

Utilizing high strength polymers with controlled pore dimensions as support, Giner proposed and created a stronger membrane electrode assembly (MEA) with optimized electromechanical performance and greatly improved mechanical properties that can operate at higher temperatures and pressures. MEAs are used to separate hydrogen and oxygen by passing direct electrical current through water and they are at the heart of Proton Exchange Membrane (PEM) electrolyzers used by NASA in electrolyzers and fuel cell stacks.



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PEM electrolyzers offer smaller, cleaner and more reliable systems than competing electrolysis systems. To reduce costs, Giner has developed and demonstrated long-lived PEM cell stacks which require 1/4 of platinum to operate, compared to other platinum PEMs, and is targeting an additional 33% reduction in the amount of precious metals needed for PEM manufacture.

> "The SBIR has been instrumental in our commercial success in taking our hydrogen refueling station and energy storage system to market and has given us an advantage over international competition"
>
> **DR. CORKY MITTELSTEADT**
> VICE PRESIDENT OF TECHNOLOGY
> GINER, INC.

Aerospace PEM technology has become lighter and more efficient as a result of recent work conducted for regenerative fuel cell applications. Now, high and low pressure breathing oxygen can be provided by PEM systems. This has also opened up the door for Giner to be a major player in the vehicle recharging industry, with the production of hydrogen being a necessary component.

Giner is actively engaged in many facets of current and future energy production and automotive applications of electrochemical technologies. The company's hydrogen generators produce pure hydrogen fuel from water and electric power at high efficiencies. Working with key private and public sector partners, including the Department of Energy and General Motors, Giner is pushing the boundaries of its proton exchange membrane technology to improve efficiency, costs, reliability and durability.

In large scale applications, regenerative fuel cells are the lightest means of storing energy, and thus have applicability across a wide range of sectors. Giner has built and tested complete regenerative fuel cell systems for autonomous undersea vehicles, high altitude airships, airplanes, and spacecraft.

Giner has sold two large systems to its commercial clientele. The first is a hydrogen refueling station in Germany for automobiles, and the second is a solar energy storage application in France. The company is currently building three hydrogen refueling stations in California.

"The SBIR has been instrumental in our commercial success in taking our hydrogen refueling station and energy storage system to market and has given us an advantage over international competition," adds Mittelsteadt. "It's very difficult to self-fund some of these innovations and SBIR not only allows us to do that but also gives us a chance to do a deeper dive with the technology and apply it to areas that weren't originally anticipated."